Space Weather Technical Forecast

Issued on Sunday, 27 March 2022 at 00:47 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Chance of G1/Minor Storm intervals days 1 & 2 (27th & 28th), including potential CME arrival.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low with a single C2 flare from the southeast limb at 26/1540UTC. AR2976 Eho/Beta and AR2975 Cso/Beta in the northeast form a wider sunspot complex but remain largely stable with only minor changes. The much smaller group AR2974 Axx/Alpha (which produced the M1 flare on 25th) has been inactive and continued to decline.

No Earth directed CMEs have been observed, though a glancing blow remains possible from a CME originating on 25th.

Solar Wind / Geomagnetic Activity: The solar wind as observed by DSCOVR at L1 has been relatively stable fluctuating between 380-430 km/s. The density was around average until 26/1430 UTC, when it rose above average with a peak of 17ppcc observed at 26/2300 UTC. The strength of the interplanetary magnetic field (IMF), Bt, was mostly weak but with a couple of brief spells at Strong with a maximum of 9 nT observed at 26/2021 UTC. The north south component Bz strengthened a little throughout, ranging +7 to -7 nT, with no specific trend in orientation. Phi angle was predominately positive (away from the Sun). Geomagnetic activity was Quiet to Unsettled (Kp 0-3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) measured at GOES 16 was at Background levels. The high energy electron flux (greater than 2MeV) has been predominantly at Normal Background levels, with the 24-hour integrated electron fluence rising slightly, but well below the Active (1e8 integrated pfu) threshold. Observed fluence at 27/0000 UTC was 2.91e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is expected to be Low to Very Low, but with a slight chance (10%) of further isolated M-flares possible.

Solar Wind / Geomagnetic Activity: The 25th March CME arrival is expected 27/2300 +/- 10 hours, likely with a glancing impact, although some uncertainty. Fast wind of CH69 is expected to arrive at Earth early day 1 (27th) and persist into day 2 (28th) due to the anticipated CME. Solar winds easing again day 3 and into day 4 (29th and 30th). Quiet to Unsettled geomagnetic activity will soon become Active with a chance of G1/Minor Storm intervals from the arrival of CH69 during day 1, then again from the arrival of the CME late day 1 or into day 2. Activity likely easing to Quiet to Unsettled days 3 and 4 (29th and 30th).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux is expected to be at Background levels throughout the forecast period, with only a very slight chance of rising above background levels from the one large sunspot on the disc. The high energy (greater than 2 MeV) electron flux is currently at background, with a chance of rising to Moderate to High in response to the fast wind of CH69, but with a likely period of drop out with the CME arrival either late 27th or early 28th. The associated 24 hr fluence will likely persist

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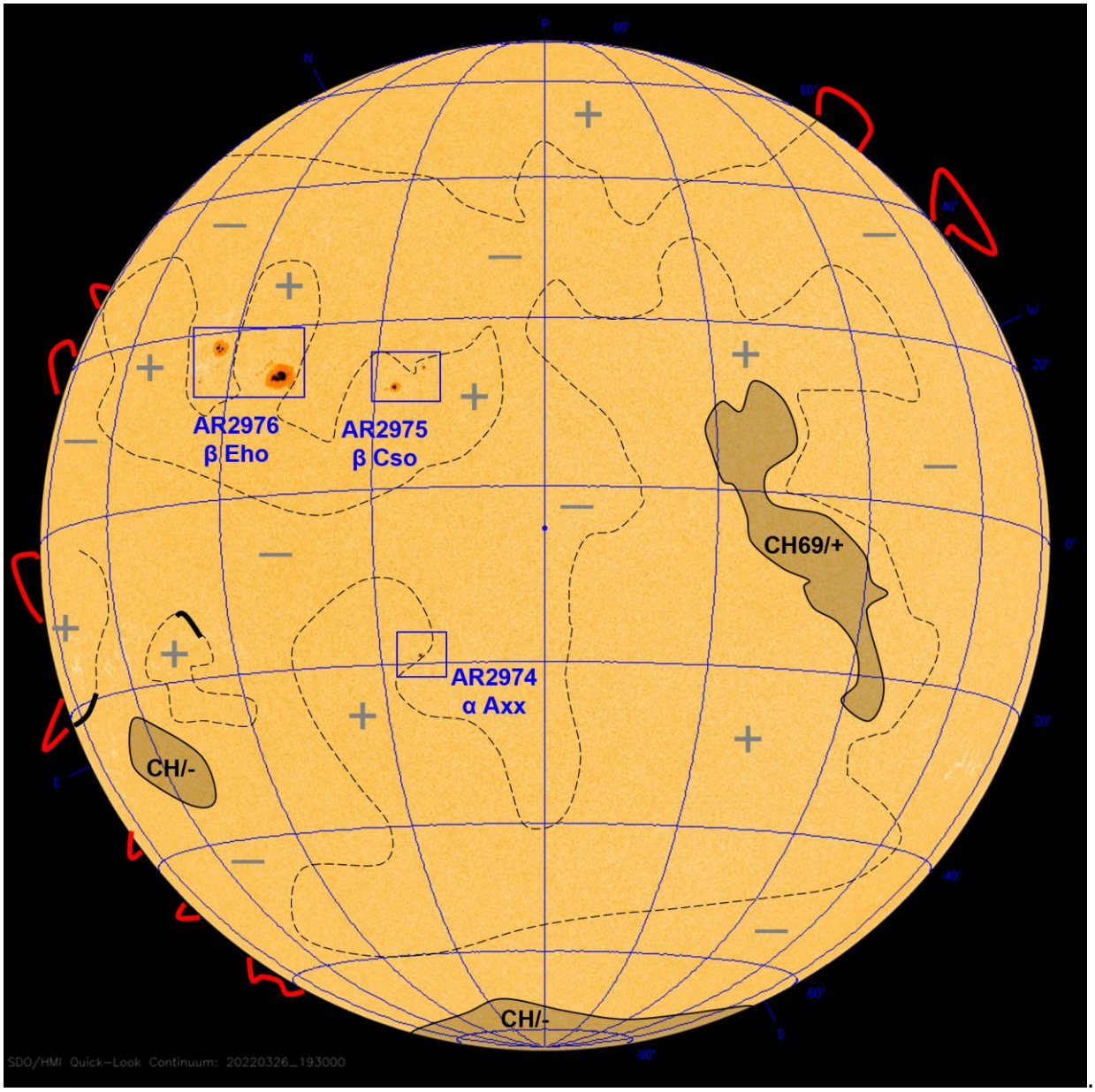
below the Active (1e8 integrated pfu) threshold but with a chance of rising above day 3 or 4 (29th or 30th).

Figure 1. Solar Analysis Valid 26/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

There is a CME which has the potential for a glancing impact at Earth, from the M1.5-flare of AR2974 on the 25th. There is some notable uncertainty with the timing of this CME, and extent of impact, due to a difficult assessment on the westward extent of the CME in available imagery. Current expected arrival time is 27/2300 UTC +/- 10 hours.

Solar winds are expected to become enhanced day 1 (27th) due to the arrival of the fast wind of CH69. This is in-line with observations at STEREO A and is supported by Enlil, which also indicates a slight speed increase into 27th. These elevated winds will persist and likely stay enhanced day 3 (28th) due to the CME arrival.

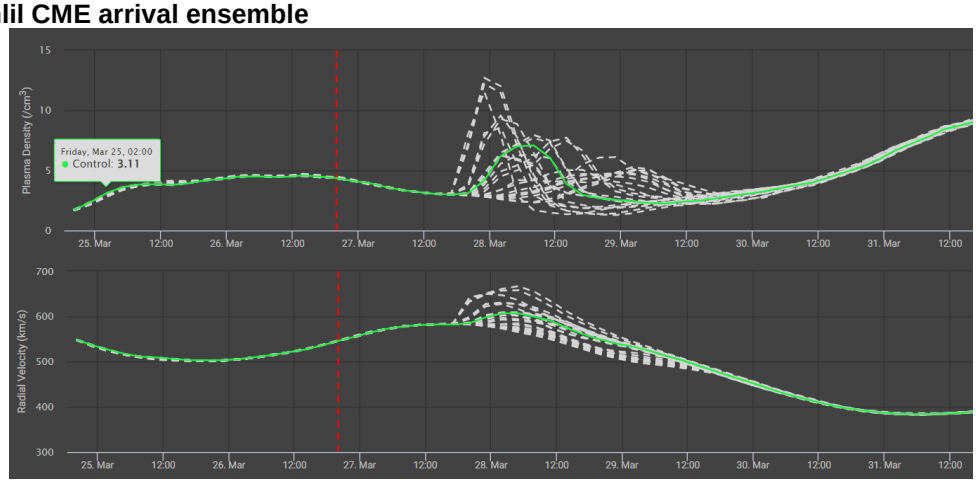
Quiet to Unsettled geomagnetic activity will become Active with a chance of G1/Minor Storm intervals from the arrival of CH69 during day 1 (27th), and then again later day 1 and into day 2 (28th) from CME arrival. Activity likely easing to Quiet to Unsettled days 3 and 4 (29th and 30th).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	40	40	10	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
26/0904	Full Halo	M Flare	SE	560	27/2300 +/- 10hrs	Likley glancing blow

Figure 2: Enlil CME arrival ensemble



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Radio Blackouts - X-Ray Flares:

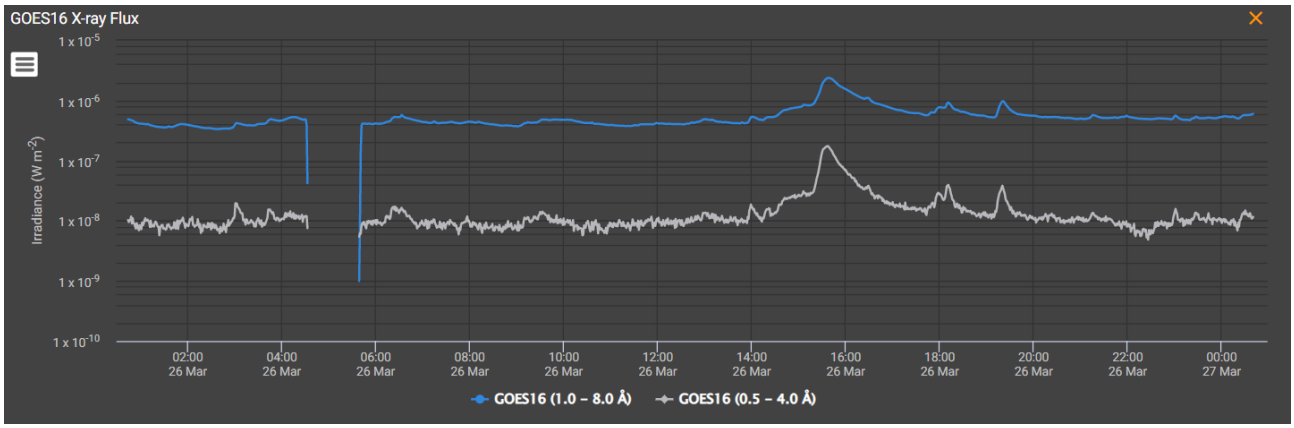
There are currently three numbered sunspot groups on the Earth-facing disc, all located in the eastern hemisphere. AR2976 is the largest group in the northeast quadrant, and is now a mature stable open region. AR2975 continues to change with a small leader spot developing recently. AR2974 (in the southeast quadrant) was the source of the M1 flare on 25th, but remains a small and simple unipolar spot.

Also of interest is a bright flux region on STEREO A euvi imagery, that corresponds to a region identified on far-side products, and expected over the east limb day 1 (27th). This was the source of the C2 flare at 26/1540 UTC and has the potential for further activity.

Solar activity is expected to be Low to Very Low, but with a slight chance (10%) of further isolated M-flares possible.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	10	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: Xray trace past 24 hours GOES16



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Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (10MeV) measured at GOES-16 is currently expected to remain at Background levels throughout the forecast period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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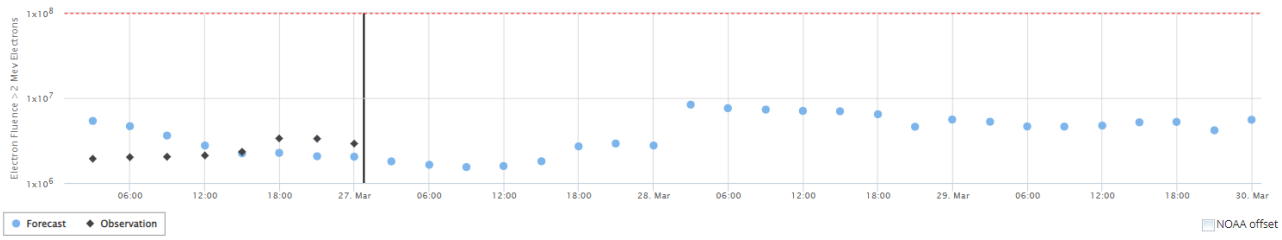
High Energy Electrons Event (≥ 2MeV):

The high energy (greater than 2 MeV) electron flux as observed by GOES-16 at GEO is currently at Background but likely to rise day 1 (27th) due to the arrival of the fast wind of CH69. This is further complicated by a likely CME arrival either late 27th or early 28th, likely causing a drop out to observed flux levels when it arrives. Despite this, periods of Moderate to High are possible on the 27th, and perhaps returning once any CME affects subside.

The associated 24 hour fluence is expected to rise from any moderate to high flux from the fast wind of CH69, although likely staying below the Active threshold, due to the potential CME arrival. However there is a slight chance that Active fluence does develop, with some uncertainty around the strength and timing of the CME. REFM is currently giving good guidance up to T+24, with fluence forecast to remain below the threshold. However beyond this period, any fast wind influence is likely to increase fluence above REFM values with a chance of reaching Active levels by the end of the period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	5	10	20	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: REFM observed and forecast electron fluence.



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